



# Improving Sampling, Analysis, and Data Management for Site Investigation and Cleanup

The United States Environmental Protection Agency (EPA) supports the adoption of streamlined approaches to sampling, analysis, and data management activities conducted during site assessment, characterization, and cleanup. This position reflects the growing trend towards using smarter, faster, and better technologies and work strategies. EPA is coordinating with other Federal and State agencies to educate regulators, practitioners, site owners, and others involved in site cleanup decisions about the benefits of a streamlined approach. Ultimately, EPA expects to institutionalize these newer approaches and anticipates that the principles will guide the way data are collected and analyzed for future site cleanup decisions.

## The Approach

The trend towards modernization and streamlining relies on a three-pronged or "**triad**" approach. It incorporates:

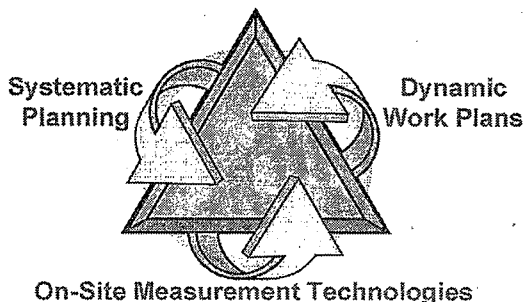
■ **Systematic planning** for all site activities, ensuring that the end goals for each project are clearly identified. Once goals are defined, systematic planning involves charting the most resource-effective course to reach those end goals. A team of *multi-disciplinary, experienced technical staff* works to translate the project's goals into realistic technical objectives. The conceptual site model (CSM) is the planning tool that organizes what is already known about the site and helps the team identify what more must be known to make the decisions that will achieve the project's goals. The systematic planning

process ties project goals to individual activities necessary to reach these goals by identifying data gaps in the CSM. The team then uses the CSM to direct field work and the gathering of needed information. This process allows the CSM to evolve and mature as site work progresses and data gaps are filled. The CSM is the key organizing tool for:

- ★ Planning site activities,
- ★ Modeling and data interpretation, and
- ★ Communication among the team, the decision makers, the stakeholders, and the field personnel.

■ The application of a **dynamic work plan** guides project teams in making decisions *in the field* about how subsequent site activities will progress. It uses a regulator-approved (as necessary) decision-tree, and is supported by the rapid turnaround of data collected, analyzed, and interpreted in the field. Success of the "dynamic" approach hinges on the presence of *experienced staff in the field*, who are empowered to "call the shots" based on the decision logic developed during the planning stage and to cope with any unanticipated issues. Field staff maintain close communication with regulators or others overseeing the project during implementation of the dynamic work plan.

The "Triad"



■ The use of **on-site analytical tools**, rapid sampling platforms (e.g., direct push technologies), and on-site data interpretation and management makes dynamic work plans possible. During the planning process, the team identifies the type, rigor, and quantity of data needed to answer the questions raised by the CSM. Those decisions then guide the design of sampling regimens and the selection of analytical tools and methods to focus data collection on providing relevant information.

Figure 1 illustrates the iterative and inter-linked nature of projects managed using this dynamic work strategy. The decision rules developed during systematic planning and built into the CSM serve as the foundation for evaluating all proposed and implemented project activities. Occasionally, decision makers will discover that the original project objectives cannot be met due to technical or budgetary constraints, and pragmatic refinement of the decision rules may be needed.

### Supporting Developments

Faster, cheaper, yet still protective, resolution of contaminated sites is achievable through the use of new technologies and the new strategies those technologies can support. If used correctly, innovative rapid-turnaround field analytical and software tools coupled with on-site decision making can significantly condense a project's overall budget and lifetime, while significantly increasing the likelihood that the gathered data will guide transparent decisions. Site professionals, policy makers, and the public should support the flexibility needed to adopt cost-effective new tools and strategies into site cleanup practice provided that clearly defined performance goals are achieved.

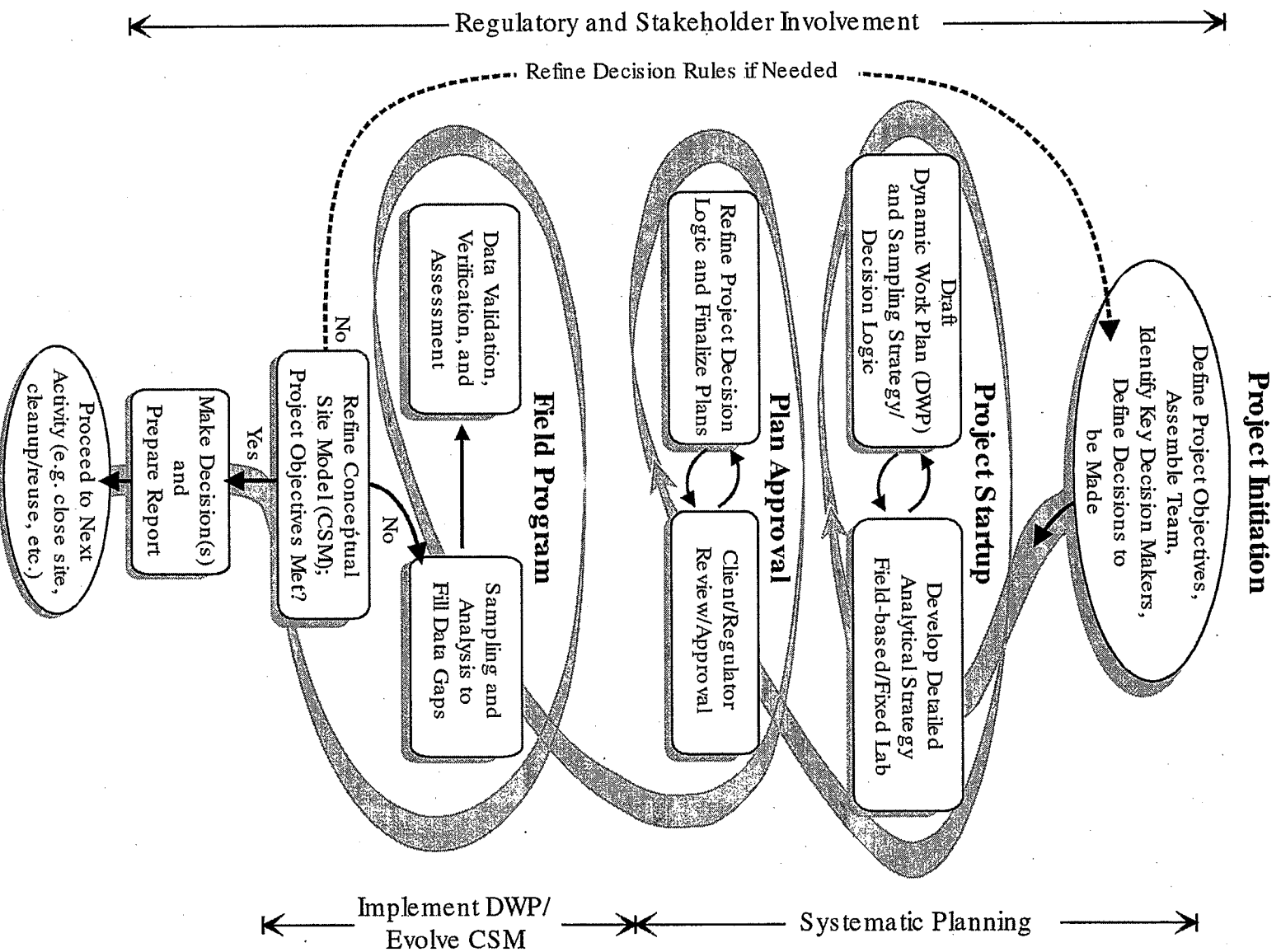
The specific developments driving the trend towards modernization and streamlining include:

- 1) **Field analytical chemistry** has made significant advances in scientific rigor and credibility. Computerization, photonics,

miniaturization, immunochemistry, and a host of other advances in the chemical, biological, and physical science disciplines are contributing to technology improvements and innovations.

- 2) Successes with **improved strategies** such as Expedited Site Characterization, Accelerated Site Characterization, Rapid or Adaptive Site Characterization, and Dynamic Workplanning are demonstrating just how cost-effective these strategies can be.
- 3) **Regulatory policies** are now focusing more on achieving tangible end-results. For example, EPA and other agencies support performance-based measurement systems (PBMS) as a preferred alternative to rigidly prescribing which analytical tools are used and how. PBMS improves the cost-effectiveness and scientific defensibility of environmental analyses by emphasizing the information and decision-making value of a representative data set and by requiring that data quality be matched to its planned use. PBMS principles support the use of field analytical technologies to meet the specified project needs and decision goals.
- 4) **Better decision-making tools (i.e., computer software and hardware)** are available that facilitate efficient and effective data management, interpretation, and decision making as the data are collected and analyzed. This allows mapping and modeling of contaminants and maturation of the conceptual site model on-site. The project team can incorporate data, modify site characterization activities, and hone cleanup decisions to minimize the number of field mobilizations.
- 5) **Modern communication technologies** mean that the field team is no longer isolated from regulators, technical experts, site owners, and trustees. New information can be shared instantly

**Figure 1**  
**Modernizing Site Characterization and Monitoring**



among parties, and regulator buy-in and technical support can be obtained from remote locations.

- 6) ***Evolving emphases in environmental programs*** [such as Brownfields, State Voluntary Clean-Up Programs (VCPs), and Base Realignment and Closure (BRAC) at military facilities] focus site activities on how the site will be redeveloped or reused. Flexible cleanup goals [such as risk-based corrective action (RBCA) levels] support faster return of these sites to productive re-use. When cleanup and end-use goals are articulated at the start, systematic planning can ensure a cost-effective work plan that achieves the desired outcome.
- 7) ***Increasing workloads and decreasing budgets*** have forced regulators and industry to consider innovative strategies that can increase public confidence and satisfaction by reducing uncertainties (about any threats the site may pose) while reducing the time and costs involved in cleaning up these sites.

### Tools for Change

To accomplish change, the remediation industry and regulators should move towards a more innovation-friendly system that can produce defensible site decisions at an affordable cost. Such a system would:

- ✓ ***Focus on decision-specific performance*** requirements, rather than inflexible adherence to arbitrary policies or "boiler-plate" procedural checklists that do not add value or provide beneficial results.
- ✓ Employ ***transparent and logical reasoning*** to define project goals, manage uncertainties, state assumptions, plan site activities, derive conclusions, and prepare ***defensible*** decisions.
- ✓ Value technical and scientific proficiency, and understand the ***need for technical experts*** in the scientific, mathematical,

and engineering disciplines required to competently manage the complex issues of hazardous waste sites.

- ✓ Require regular ***continuing education*** of its practitioners, especially in rapidly evolving technology areas.
- ✓ Facilitate application of ***innovative technologies and strategies*** by logically evaluating project-specific needs, site conditions, and prior technology performance, with residual areas of uncertainty being identified and addressed before use.
- ✓ Reward ***responsible risk taking*** by practitioners who do not fear to ask, "why don't we look into...?" or "what if we tried...?"

Pockets of forward-thinking practitioners are already successfully using and demonstrating the validity of the triad approach described above. This fact sheet and the tools referenced below are offered to encourage project managers at-large to adopt this approach into their routine practice.

### Direction

EPA, along with a number of other Federal agencies and state organizations, is accelerating the development of policies and information to support site decision makers as they shift to newer, streamlined approaches. An array of educational, training, and guidance resources already exist and additional ones are under development. Access to these resources is provided through the <http://clu-in.org> web site and are detailed in the companion fact sheet, ***Resources for Strategic Site Investigation and Monitoring, EPA-542-F01-030b.***

Updating hazardous waste site practices to accommodate these new tools and strategies has broad ramifications for both practice and policy. Revising institutional and regulatory barriers will take time and effort. Nevertheless, the benefits offered by "smarter strategies" make the effort worthwhile.